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(19) (CA) **CANADIAN PATENT** (12)

(54) Secondary Breakdown of Logs in Sawing Mills

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TITLE: IMPROVEMENTS IN THE SECONDARY BREAKDOWN OF LOGS IN SAWING MILLS

ABSTRACT

A secondary sawing line for curve sawing comprising a scanner, a chipper canter provided with an infeed guide mechanism, and an edger with guide means for curve sawing. In order to allow curve sawing, the guiding means are successively removable after adjustment, leaving only short-span guidance under the cutting procedure. According to the invention, the guide means may alternatively function symmetrically to allow sawing along the pith of the log, or fixedly at one side and resiliently at the other side, for performing so-called full taper sawing.

Figure 2

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Improvements in the secondary breakdown of logs in sawing mills

The present invention regards log-sawing and particularly sawing of logs having a curvature.

Log sawing is generally performed in at least two stages, namely, a primary log breakdown sawing, where two parallel cuts are made, sometimes combined with chipping, in order to obtain a block, i.e. a log having two parallel plane surfaces. The log is then rotated 90° for passing through a second saw rig for secondary breakdown into planks. The products of the two breakdown operations are then edged, sorted, dried, etc. A comprehensive review of the state of the art is found in "Lumber Manufacturing" by Ed M. Williston (Miller Freeman Publications, second printing, San Francisco 1978).

Only an ideal log has the straight form of an elongated truncated cone, and most logs are more or less curved. In order to obtain a maximum yield of useful wood, it is standard practice to orient the log such that the plane of the maximum curvature is parallel to the sawing plane when performing the primary log breakdown sawing. The secondary breakdown is then performed on a log having two parallel surfaces, but which is bent in the perpendicular direction. Most commonly, the secondary breakdown is then made by straight sawing seams. In this secondary breakdown, there are in principle two methods in use, namely, full taper sawing and center sawing, also called half tape sawing. In full taper sawing, the sawing direction follows a straightedge or linebar, against which the log is laid and governed, so that the opposite edge makes the full taper angle with the sawing direction. In half taper sawing, also called pith sawing or center sawing, the

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sawing direction follows the straight line approximate of the pith of the log, such that both edges make half of the taper angle to the sawing direction. From the point of view of yield, both systems are defendable. It would, however, be an advantage if the sawyer could select between both in order to obtain best individual yield. Further, for some uses, wood cut along the pith is preferred by the users.

Presently, center sawing is preferred in northern Europe, whereas full taper sawing is more common in the USA and in Canada.

Apparently, the straight sawing of curved logs, regardless of method, leads to a loss of yield, and therefore, much inventive effort has been brought to enabling sawing "around the curve", a method practiced for some fifty years in Scandinavia, using pith sawing techniques. The general principle followed for such curve sawing is to shorten the length of the steering equipment with two or more saws. Although the planks come out curved, it is a fact that after drying, automatically being straightened by stacking when dried, they come out straighter and with less warping than with "straight sawing". Further, the yield is very much increased, and cases are known where, depending on the proportion of curved logs, an improvement in yield of 12% has resulted. However, as far as known, curve sawing using full taper sawing has not hitherto been tried.

In principle, curve sawing is made with similar cutting means and aligning devices as straight sawing, with the difference that the aligning means must be positioned at mutually shorter distances. This makes guiding and aligning more difficult. The remote end of the log being treated must be given liberty to move sideways once the log has been securely entered into the cutting/sawing device

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proper, being guided by fitting guides at short intervals in the log direction. On the other hand, in order to obtain proper entry of the near end of the log, it is necessary to have pre-aligning devices, which must, however, be withdrawn once the log has been safely entered and is guided at two poisitions near to each other and to the cutting/sawing device.

It is an object of the present invention to obtain a system with a secondary saw rig which is capable of curve sawing and in which curve sawing is possible alternative using pith sawing and full taper sawing, at will, such that the sawyer can at all times select the sawing scheme which will give the best economic yield for each log.

Economically best yield is not the same as best yield in volume and may vary much from a mill to another and even from season to season, depending on what kind of plank and board dimensions are in demand. The sawyer is nowadays often computer assisted, and equipment is known for optically projecting sawing lines for various models of cuts, cooperating with automatic settings of the saws. The sawyer may then try more than one scheme on the log before selecting one of them.

Automatic setting saws, for instance such prior art circular saws which are movably mounted on a splines shaft, are particularly advantageous in combination with a guiding system for logs for obtaining the objects of the invention. The invention can however be practised with different kinds of sawing equipment, also with band saw equipment, although this will not be described.

The invention shall now be more fully explained by reference to the drawings, where
Fig. 1 A-D show the principles of secondary sawing as described above.

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Fig. 2 shows a layout of a curve sawing line.
Fig. 3 A and B show pre-aligning for center and full taper curve sawing respectively, using a chipper canter.
Fig. 4 A and B show final aligning for center and full taper curve sawing respectively, using a chipper canter.
Fig. 5 A and B show started curve sawing in a chipper canter for center and full taper sawing respectively.
Fig. 6 A and B show aligning and sawing respectively in an edger saw.
Fig. 7 A-C show a roller pair which is guidable by hydraulic cylinders for centering/aligning purposes.
Fig. 8 shows a hydraulic control system for a chipper canter and an adjustable roller pair.
Fig. 9 A-B show the control system for a roller pair in center-sawing and full taper sawing modes respectively.

In Fig. 1 A-D are shown in schematic horizontal views how the various kinds of sawings are performed on a curved log together with views of sawing seams, for curved logs. In Fig. 1 A, straight/center sawing is shown. Centering is made by rollers, and the block is then steered through linearly. The side cuts will make one board which is thin at the middle and one which is thick at the middle.
Fig. 1 B shows straight/full taper sawing, where the block is steered along a linebar at one side. Fig. 1 C shows curve/center sawing, under constant control of two pairs of rollers, which follow the sides of the block at all times, moving sideways always with equal amounts. Fig. 1 D shows curve/full-taper sawing under control of two pairs of rollers. One roller in each pair is still, whereas the other one will move in contact with the block. Thus, the two rollers kept still will form something resembling the linebar of Fig. 1 B.

In Fig. 2 is shown schematically a secondary sawing line, with a scanner 1, a chippercanter 2 provided with an infeed device 3, and an edger 4 provided with infeed

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devices and a set of adjustable circular saws. To this secondary saw line are fed blocks which are already provided with two opposite flats parallel to the plane of the paper, having been chipped and/or sawn in a direction substantially coplanar with the eventual curve plane of the logs. The scanner is of well-known type, being able to establish diameter, taper and curve, for determining how the following secondary breakdown is to be performed. The chipper canter will make chips out of some of the edge material, and the following edger will cut up the resulting block into planks. According to the invention, both those steps can be performed by curve chipping and curve sawing respectively.

When reaching the infeed device 3, the way the block is to be sawn is already decided. In particular, it is decided whether center sawing or full-taper sawing is indicated, and how the chipper canter is to be set.

For a block to be center-sawed, it is first pre-centered by two pairs 30 A, B and 31 A, B of vertical rollers mounted on swing-arms in a mechanism enabling them to move pairwise to and from a centering line 32 (Fig. 3 A). The small end of the block is entered first, and the wider end will swing out in proportion to the curvature, as shown. The block will move on under the guidance of said two pairs of rollers until within reach of a third pair of rollers 33 A, B. As shown in Fig. 4 A, in a final centering step, third rollers 33 A, B will now grip the block, whereas first rollers 30 A, B will lift off. Chipper heads 40 A and 40 B in the chipper-canter will now be set, normally at equal distances to center line 32, and the block moves on under guidance of horizontal driven roller pairs into the gap between chipper-canter rotating heads 40 A and 40 B. When the block is in a position as in Fig. 5 A, the guidance is taken over by anvils 42 A, B on the other

side of the chipper heads and which are fixedly coupled to the respective chipper heads 40 A, B, and by fourth rollers 41 A, 41 B.

The fourth roller pair 41 A, B is symmetrically movable and will be pressed by hydraulic means toward the center line. The chipper heads are set slightly toe in (about one millimeter, not seen in the drawing), and the anvils 42 A, B are set at the front edge distance of the chipper heads. This makes it possible for a curved block to steer through, maintaining substantially its curvature. The distance between the fourth roller pair 41 A, B and the anvils 42 A, B is of the order of one meter, and the Figures are drawn to scale.

The curved block which exits from the chipper canter is provided with two parallel flats in the horizontal direction, whereas the "flats" made by the chipper canter in the vertical direction are vertical and parallel but lengthwise curved. Although the edges may not be filled out everywhere, the cross section is substantially a right rectangle, often a right square. For the further division of this block by curve sawing, the curved vertical surfaces are used for guidance, and the previous cutting will determine if the further sawing is along the pith or according to the principle of full taper. The guide rollers of the following edger may therefore be arranged for symmetrical movement. In order to obtain curve sawing, it is, however, necessary to use "short" guidance. Fig. 6 A and 6 B show this guidance.

As the logs are treated small end first, the end first entered in the edger may have its theoretical form less than filled out, such that it is unsuitable for precise guiding. Aligning before introduction must therefore be made using longer guidance than is then used for curve

sawing. As shown in Fig. 6 A and 6 B, there are therefore two guiding systems comprising a pre-aligner 60 A, 60 B followed by an aligner 61 A, 61 B, each comprising two bars with opposing rollers and movable in opposition and symmetrically. The log is introduced and aligned by means of all the rollers as shown in Fig. 6 A. Once sawing has started, the pre-aligner bars 60 A, 60 B are swung away as shown in Fig. 6 B, and guidance is then assured by the rollers on bars 61 A, 61 b together with the saws and eventually by knives 62 a, 62 b which follow cut seams, particularly in the outermost seams where less than perfect side boards are likely to result but the seam will most likely be at full height. After exiting, curve sawed planks and boards are obtained, which may be further sawn and which after proper drying will be straight.

The previous description has mainly regarded the curve sawing following the pith, i.e. center sawing. As already mentioned, the inventive machinery makes it possible alternatively to use the full taper sawing principle in curve sawing.

The principle of straight full taper sawing is shown in Fig. 1 B, and the idea then is to let the block be guided along a material long linebar at one side, which linebar is parallel to the cutting or sawing direction. In curve full taper sawing, as shown in Fig. 1 D, the linebar is then exchanged for a set of rollers which are kept immobile, mounted on one side of the block, with opposite rollers which move to fit the changing width of the block. As the distance between the two fixed-axis rollers forming the "linebar" is short, a curved block will still be cut along a curve.

In order to obtain the possibility of working with both methods, it is necessary for the roller pairs of the chipper canter to either move in a coupled way to and from

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a common center, or let one roller stay fixed, whereas the opposite roller can move to and from the fixed roller. Such a roller pair construction will be described.

When the sawing line of Fig. 2 is to perform a full-taper sawing, the pre-aligning step as shown in Fig. 3 B is performed by setting rollers 30 A and 31 A along a non--material linebar, outside of the cutoff plane defined by cutter head 40 A. Also roller 33 A is set colinear with the same non-material linebar. As shown in Fig. 4B, rollers 30 A, B are lifted off when the block is final aligned by roller pairs 31 A, B and 33 A, B. In the sawing operation (Fig. 5 B), the guidance is given by roller 41 A, fixed on the imaginary "linebar", and movable roller 41 B before the chipper canter, and by anvils 42 A, B after the chipper canter. Roller 41 B will hold the block by resilience against fixed roller 41 A. The chipper heads being slightly toe-in (not seen in Figure), the block can be cut in a curvature, the distance being about one meter between roller 41 A and first cutting edge of cutter head 40 B. Anvils 42 A and 42 B are following the positions of the respective chipper heads 40 A, B.

In order to obtain the advantages of the invention, it is necessary to have a roller pair control mechanism which satisfies the condition that it can either be set to be movable symmetrically to a center line, or with a first roller settable to a predetermined position, the second roller of the pair being resiliently movable toward the first roller.

In the embodiment disclosed, two different methods are used for obtaining alternatively the two kinds of movement, one on mechanical principle, the other on hydraulic principle.

The first method is used for roller pairs 30 A, B, 31 A, B

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and 33 A, B shown in Fig. 3-5. Fig. 7, 8 and 9 show the method. Two rollers 80 A, B are mounted on links 81 A, B, which are swingable around swing-points 82 A, B. Fixed on respective links 81 A, B are arms 83 A, B, the ends of which are articulately coupled at 83 A, B to respective ends of a first hydraulic cylinder 84. On link 81 B is further fixed a further arm 85, to which is articulately fixed one end of a second hydraulic cylinder 86, the other end of which is articulately fixed at swinging-point 87. Swinging-points 82 A, 82 B and 87 are fixed on a carrier 88, which can be linearly displaced by a third hydraulic cylinder 89.

The advantage of this system is that symmetric movement of the jaw consisting of rollers 80 A, B can be substantially obtained, centered on line 32, by actuating only first cylinder 86, letting second cylinder at constant length (Fig. 7 A). Center line 32 may be displaced by actuating third cylinder 89.

For full taper sawing, cylinder 86 is set at a predetermined position as in Fig. 7 B, e.g. at maximum stretch. Roller 80 B will take a predetermined position. Now, roller 80 A can be moved independently by means of cylinder 84.

In order for the first-mentioned symmetric jaw movement to be substantially obtained, a certain symmetry is needed. In Fig. 7 A, the rollers 80 A, 80 B, are shown in a "mid position", corresponding to a mean block size. The first hydraulic cylinder 84 is set at minimal length and is articulately joined to arms 81 A, B at joints 83 A', 83 B', which are at equal distances from the respective fixed swinging-points 82 A, 82 B. Further, in this mid--position, lines joining 82 A - 83 A' and 82 B - 83 B' are at right angles to the line joining joints 83 A' and 83 B'. It is not difficult to see that if arm 81 B is

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swung a small angle by means of second cylinder 86, arm 81 will swing in the opposite sense and with a substantially equal angle. The error is surprisingly small within a swing angle of 12.5°, corresponding in Fig. 7 A to a closing of the "jaw". With arms 81 A, B of a length of 380 mm, the center line will only move about 0.16 mm.

An analysis shows that what is necessary for such a construction to work is that two minimum conditions must be satisfied for the position corresponding to the middle of the working interval, namely, firstly that for that position, the tierod line drawn between articulate joining points 83 A', 83 B' intersects the line between swinging-points 82 A, 82 B at its midpoint, and secondly that the normals drawn from swinging-points 82 A, 82 B to the tierod line are of equal lengths. Those conditions are sufficiently approximated for the demands at introduction.

Fig. 7 C shows the positions of the rollers when both first and second cylinders are at their shortest length. This is the infeed open position. For centersawing, thus, the second cylinder 86 is activated and will center a block relative to center line 32. For linebar full taper sawing, the second cylinder 86 is set at e.g. its maximum length, whereas the first cylinder 83 is given a pressure to bring it to shorten.

The cylinder pair 41 A, 41 B at the immediate entry of the chipper canter is controlled in another way. Fig. 8 and 9 A-B show the hydraulic system of the chipper-canter. As recited above, the chipper heads 40 A and 40 B may be individually adjustable. This is done by setting cylinders 40 A', 40 B', which each move a slide, on which the respective chipper head is mounted together with roller mechanisms for rollers 41 A, 41 B and anvils 42 A, 42 B respectively. The anvils (not shown) are strictly following the chipper heads, as they are to contact the "planes"

cut by the chipper heads. The rollers 41 A, 41 B on the other hand are to roll against the block edges as they are before chipping. According to one mode, one of them is to be held fixed, the other resiliently pressing against the block, according to the other mode, they should center the block by moving oppositely in unison.

In Fig. 8, it is shown how the chipper heads together with slides may be displaced by actuating valves 40 A", 40 B". Rollers 41 A, 41 B are displaced by cylinders 100 A, 100 B.

This hydraulic construction is sufficiently precise to guarantee high-precision sawing to obtain a product which has good tolerances.

In order to obtain the two modes of moving by means of hydraulic means, Fig. 8 and Fig. 9 A-B show the general principle. A hydralic source 101 having a pressure line P and a return line T is coupled as shown in Fig. 8 through a control device 200 provided with a switch 102 and a one-way valve 105. For each of the hydraulic cylinders 100 A and 100 B, there are provided further switches 103 and 104 respectively.

The control device receives on the input the lines P and T and outputs via the switch 103, one of the outputs passing via the one-way valve 105. Said two outputs and a direct return line coupled to T are coupled via switches 103 and 104 to the respective hydraulic cylinders 100 A and 100 B. Thereby, the output from the one-way valve 105 is split into two, making four lines go to the switches 103 and 104.

In operation, it is possible to make the cylinders work either in symmetry for curve/center sawing (Fig. 9 A) or by keeping one cylinder fixed (Fig. 9 B). For one cylinder to stand still, it is sufficient for that cylinder to have both feed lines closed, and switch 104 therefore has one

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position where both are closed, as shown in Fig. 9 B. For symmetrical inward movement, the respective switches 102, 103 and 104 are set as in Fig. 9 A. In this position, cylinder 100 B will prolong, the other side of its plunger displacing equal amounts of oil, which displaced oil will go to prolong cylinder 100 A, since one-way valve 105 will prevent that oil from returing to the T line, as shown with a bar in Fig. 9 A. The oil displaced thereby from cylinder 100 A will go freely to line T. The rollers moved by those cylinders will thus move in unison and symmetrically toward a common center. When the rollers are to move out to their opposite positions, it is sufficient to change the switch 102 and set switch 104 in its opposite position (see Fig. 9 A), and the cylinders will move to their opposite end positions, which are the starting positions for next operation.

This hydraulic movement is very precise and has further the advantage of enabling a device which has small dimensions in the length direction of the log and may therefore be placed near to each other and to cutting equipment. This makes it easier to perform curve sawing, and the hydraulic movement is preferred for the guide means nearest to the cutting/sawing devices, whereas the "mechanical" means previously described are preferred for pre-aligning purposes.

In both cases, it is suitable to have a stabilized/limited hydraulic pressure to press the rollers toward the log. An exemplary embodiment of such a stabilization is shown at 110 in Fig. 8 and consists in a bypass valve regulated by a pressure sensor for setting a suitable pressure for obtaining resilient pressure of rollers against the log.

There have now been described means for curve sawing including guide means whereby both center sawing and full taper sawing may be performed in the same machinery.

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Obviously, the various mainly hydraulic movements must be controlled such that they are activated in the right order in order to perform the described functions. The various control and sensing devices for performing this task are obvious to an engineer familiar with standard automatic control systems and would normally be computer assisted. This being the case, it has not been seen as suitable to describe the further control equipment, being well within the grasp of one familiar with the art of industrial control.

Not shown in the Figures and not described is the forward feed. As is conventional, this feed is obtained by meas of horizontal driven roller pairs, one in the bottom plane where the log is moving, another vertically adjustable, forming a roll nip with the former. As this feed is conventional, it is not described.

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CLAIMS

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1. In a secondary breakdown saw line having log transport and feed means, and admitting of curve sawing, an infeed adjustment device followed by a chipper comprising two sideways movable chipper heads rotatable on horizontal shafts and a sawing device comprising a plurality of sawing means for making parallel sawing seams, which sawing device has guide roller means for guiding a log treated by the chipper heads in adjusted manner through the sawing device, the improvement comprising in said infeed adjustment device of a plurality of roller pairs rotatable on vertical shafts, and means for selecting sideways movement of the rollers in a first mode, in which the rollers are adapted to move in unison and symmetrically from and resiliently toward a common center, or, in a second mode, in which one of the rollers in each said pair is maintained at an adjustable fixed position, while the other roller of each pair is movable from said one roller and resiliently toward the roller maintained in said fixed position.

2. For chipper canter machine provided with two chipper heads rotatable on individual horizontal shafts and movable to and from each other for creating a gap for cutting vertical opposite plans on a log block guided therethrough, feeding and guiding means for bringing a log block through said gap, said guiding means comprising an infeed device having a plurality of roller pairs rotatable on vertical shafts and movable in a horizontal direction to and from a line parallel to said gap for successive entering in contact and removing from a log block transported therebetween,

a pre-guide roller pair situated immediately in front of said chipper heads, rotatable on vertical shafts and movable to and from a log transported therebetween, and a pair of guide means, each solidary in movement with one of said chipper heads and coplanar with the said vertical opposite plans cut on a log block, all said rollers being controlled for either resiliently urging in symmetric movement against a log relative to a respective midpoint or for one thereof residing fixedly and the other resiliently urging a log against the other roller of the same pair,

each pair of said plurality of roller pairs being arranged to activate movement against a log block and to remove therefrom in succession and such that when

cutting never more than two of said pairs of said plurality of rollers, said pre-guide roller pair and said pair of guide means make contact with a log guided through the chipper canter machine.

3. A guide roller pair system for introducing logs of timber into a machine for curve sawing secondary breakdown alternatively by center sawing and full taper sawing, having a pair of parallel vertical guide rollers fixed to separate arms which are swingable around axes parallel to the respective guide rollers, and which are fixed to a frame, a first hydraulic cylinder swingably fixed with one end to one of said separate arms and with its other end to the other of said arms at fixing-points on the respective arms which have equal distances to their respective axes thereof, a line joining said fixing-points crossing another line joining said axes,
and a second hydraulic cylinder swingably fixed with one end to the frame and with its other end to a first one of said separate arms, such that a hydraulically driven change in the length of only said first hydraulic cylinder will move only the second one of said separate arms and therewith only the roller thereof, and such that a hydraulically driven change in only said second hydraulic cylinder will make the two rollers move substantially symmetrically to and from a common middle point between the two.

4. A guide roller pair system of claim 3, each roller having a useful stroke of movement toward and from each other, wherein at half said useful stroke for the two rollers, a first line drawn between the fixing points of said first hydraulic cylinder forms right ranges with respective lines drawn from said fixing points to said respective axes for swinging said separate arms, and a second line drawn between said respective axes intersects said first line at its midpoint.

5. A guide roller pair system for guiding logs through a log cutting device and permitting of cutting curvedly and selectably according to a center cutting or a full taper principle, said rollers of the pair being rotatable on vertical shafts and movable in directions perpendicular to their shafts, each roller in the pair being movable by a hydraulic cylinder of equal diameter, a hydraulic fluid source for a substantially incompressible fluid, said source

having a pressure output and a return input, and feed control means for feeding fluid to said two hydraulic cylinders including means for feeding in a first operation mode of said fluid from said pressure output to a first of said hydraulic cylinders at one end thereof for nearing its said roller toward the other roller, and for feeding fluid thereby expelled from the other end of said first hydraulic cylinder exclusively to the second of said hydraulic cylinders at one end thereof for nearing its said roller toward the said first-mentioned roller with equal amount, and for feeding fluid expelled from the other end of said second hydraulic cylinder to said return input, and in a second operation mode to feed said fluid from said pressure output only to said first of said hydraulic cylinders at said one end thereof, and for feeding fluid thereby expelled from the other end thereof to said return input, said second hydraulic cylinder being immobilized by said feed control means.

6. A guide roller pair system of claim 5, wherein said feed control system comprises a shunting pressure control system for controlling the pressure at the source pressure output and for obtaining a resilience of said rollers when moving against a log introduced between said pair of rollers.

7. A guide roller pair of claim 5 or 6, wherein said feed control system comprises a first switch having two inputs and a first and a second output, for switching said pressure input and return input of said source alternatively to said first and second outputs, a one-way valve coupled with its allowing entrance to the first of said outputs and with its allowing exit to an input of each of a second and third switch, said second output of said first switch being coupled to another input of said second switch, said return input of said source being also coupled to an input of said third switch, said second and third switches having outputs coupled to opposite ends of said hydraulic cylinders, said second switch allowing of switching its said inputs alternately to its said outputs, said third switch allowing of switching its said inputs alternately to its said outputs and also allowing of breaking connection to its said outputs.

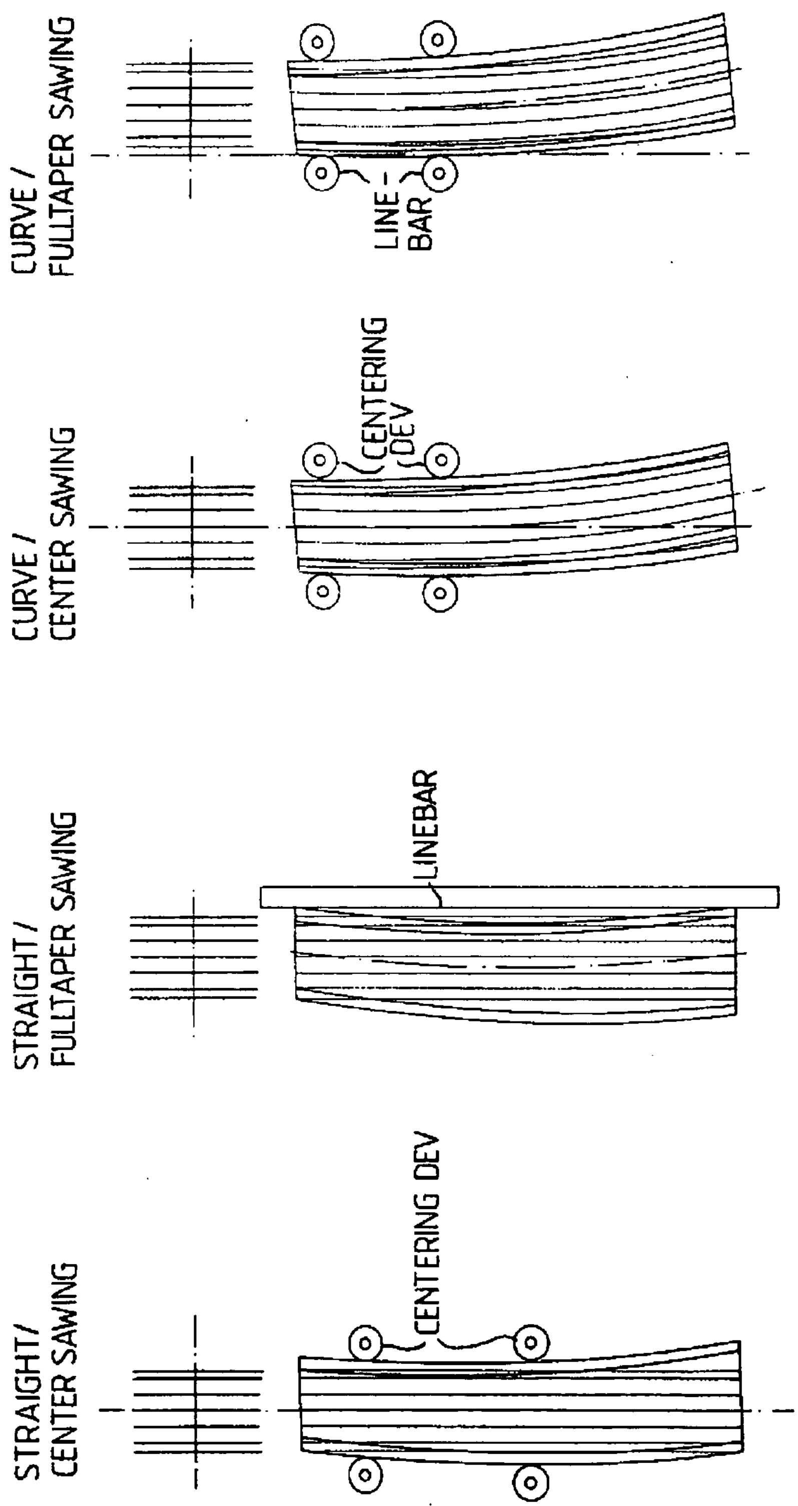
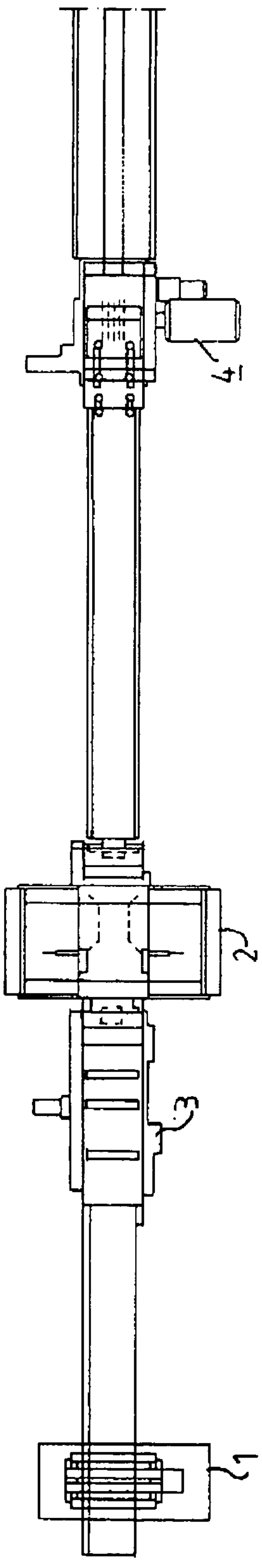


FIG.1A

FIG.1B

FIG.1C

FIG.1D



LAYOUT CURVE SAWING LINE

FIG. 2

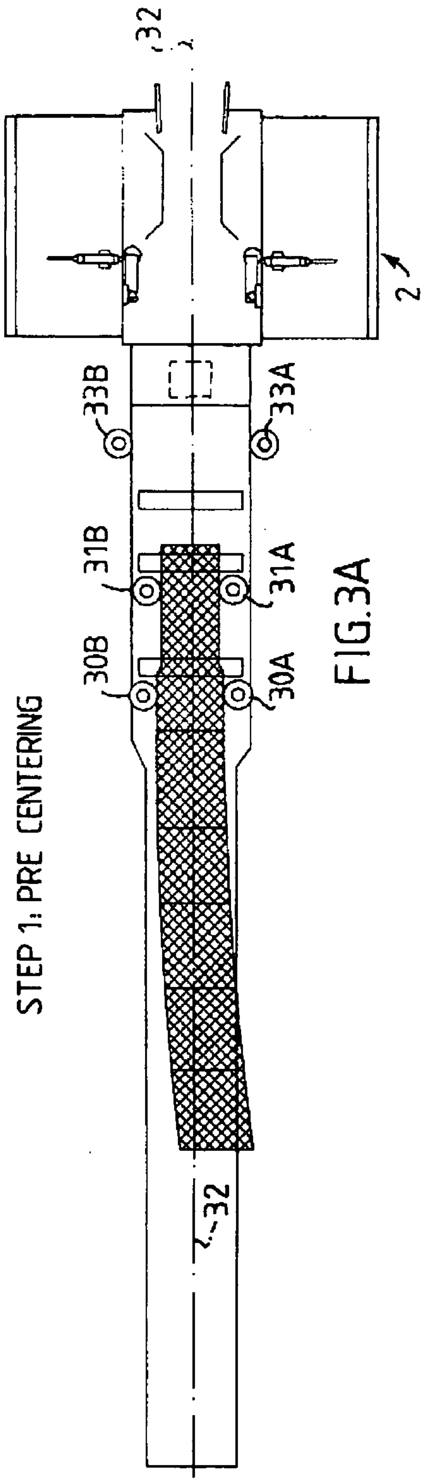


FIG.3A

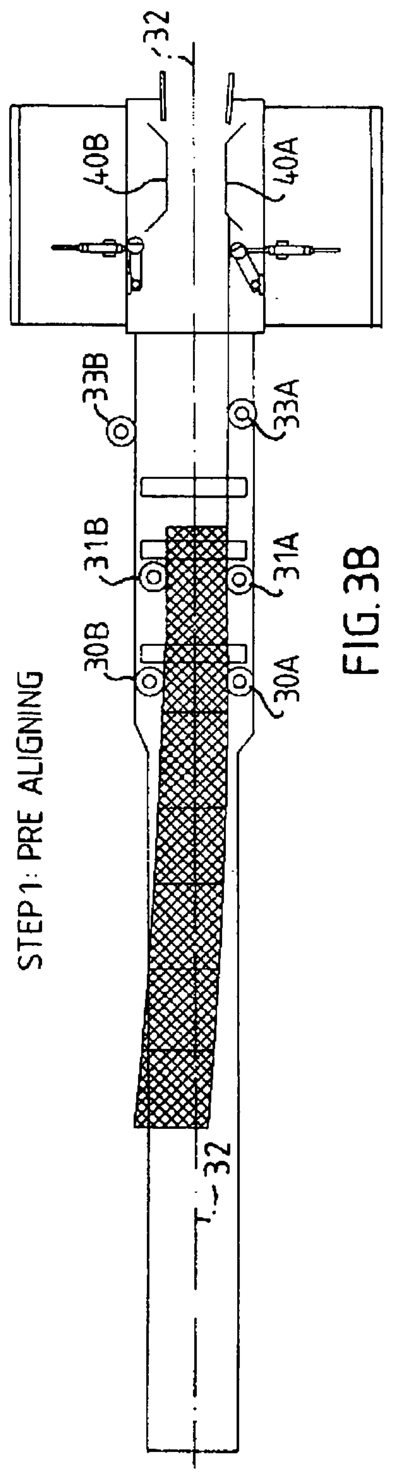


FIG.3B

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CURVE/CENTER SAWING IN CHIPPERCANTER
STEP 2: FINAL CENTERING

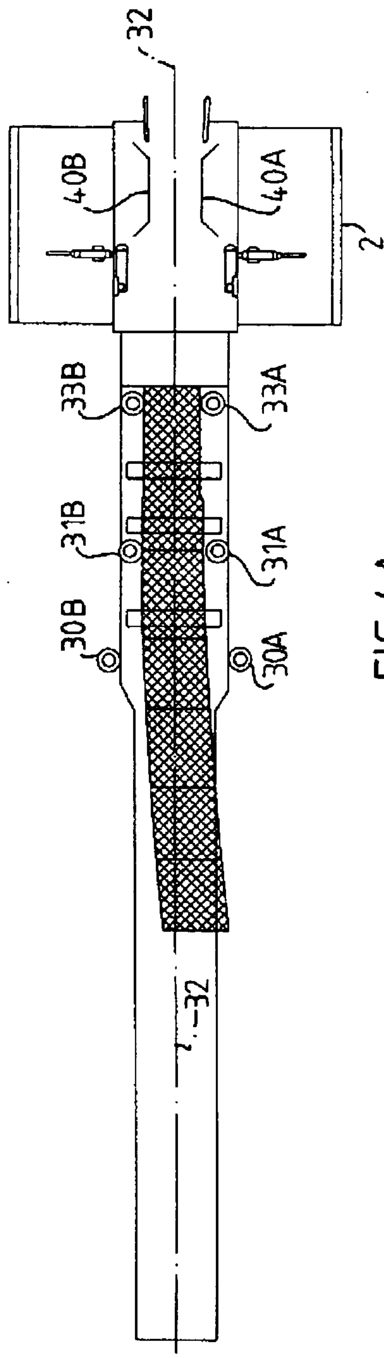

FIG.4A

CURVE / FULLTAPER SAWING IN CHIPPERCANTER
STEP 2: FINAL ALIGNING

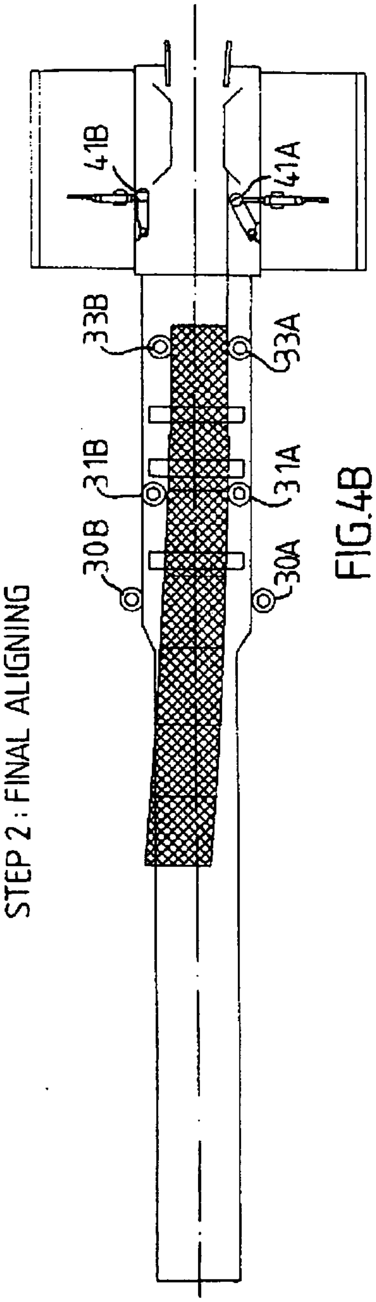

FIG.4B

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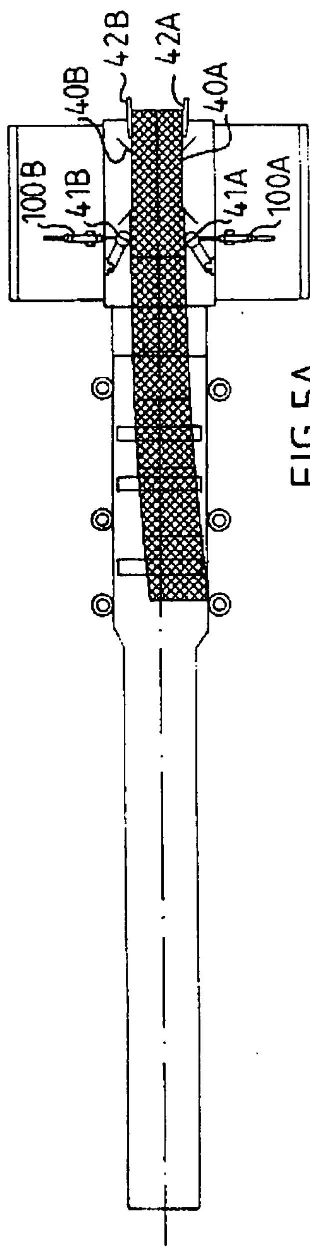
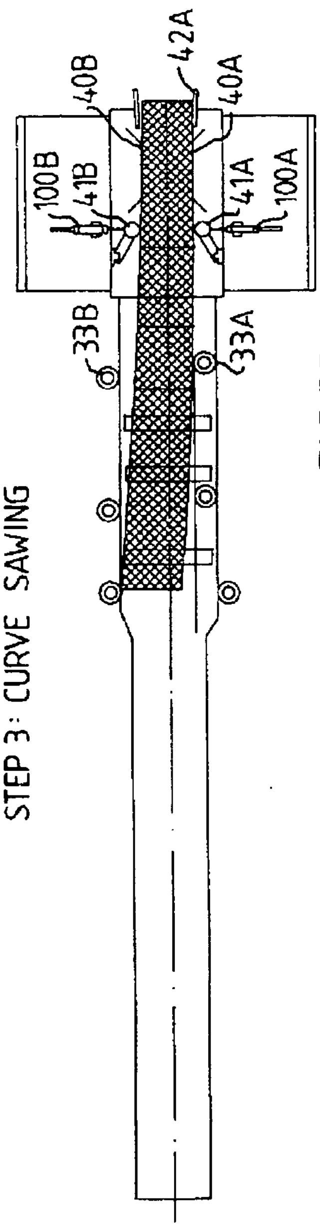


STEP 3: CURVE SAWING

FIG.5A



STEP 3: CURVE SAWING

FIG.5B

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CURVE SAWING IN EDGER

SAWING OF CURVED CANT

ALIGNING OF CANT

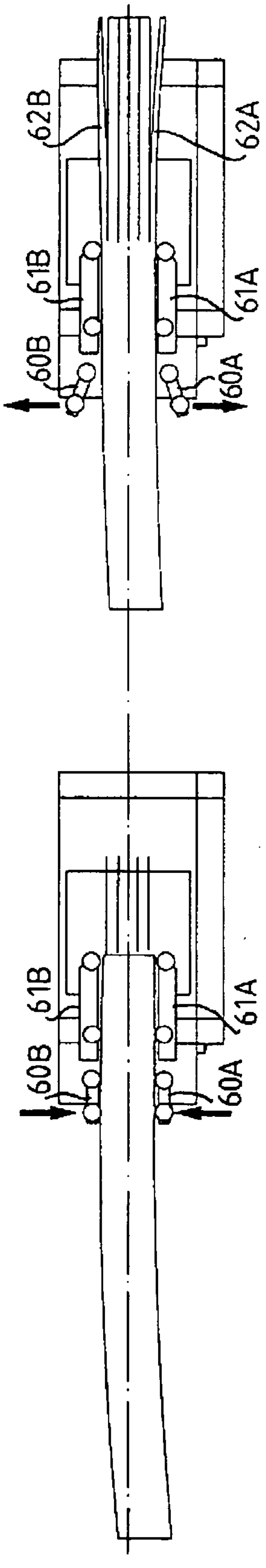

FIG.6B

FIG.6A

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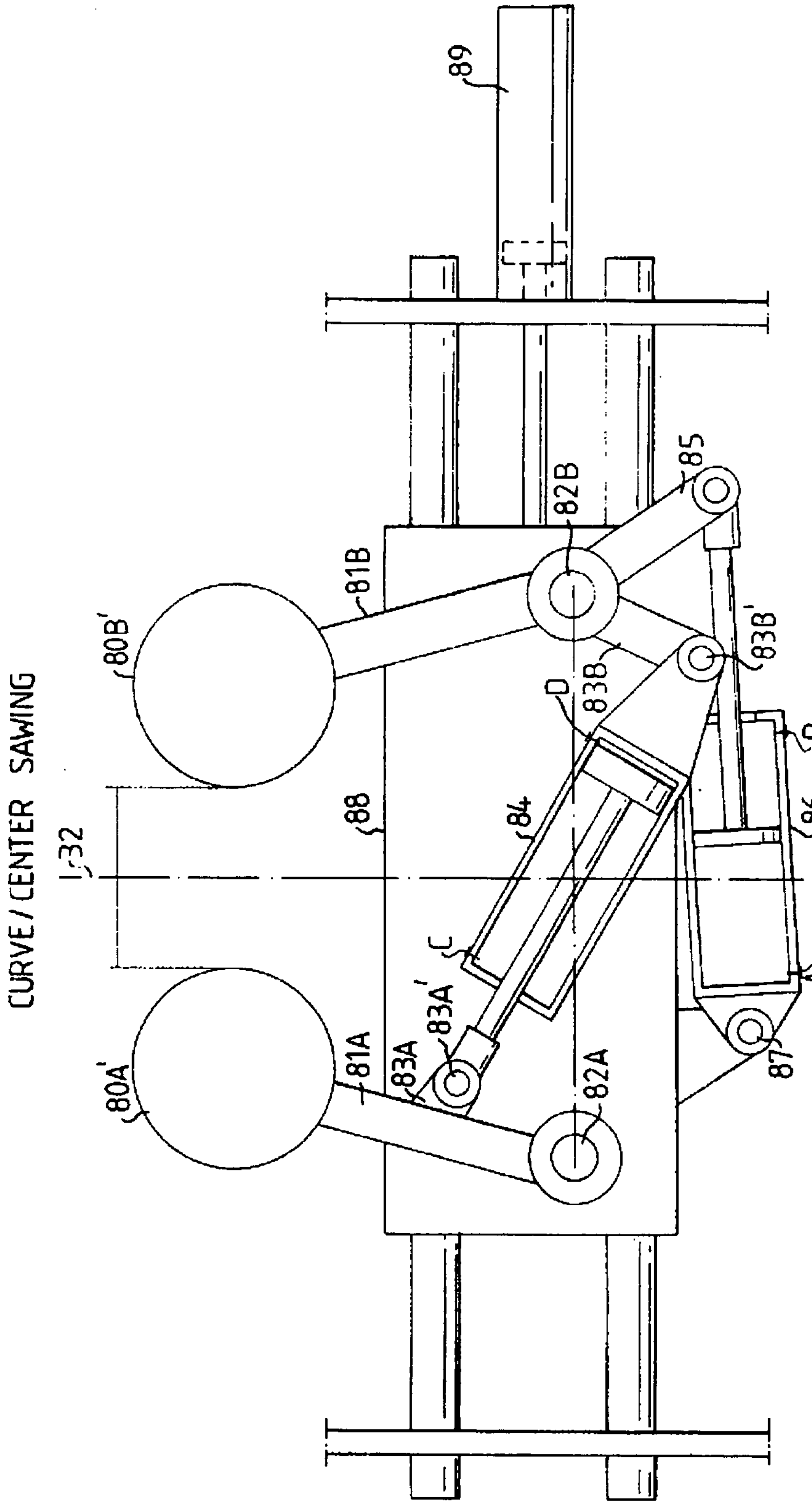
CURVE / CENTER SAWING
89
85
82B
81B
80B'
83B'
83B
D
B
88
84
86
C
83A'
83A
81A
80A'
82A
87
A

FIG.7A

A

2022857

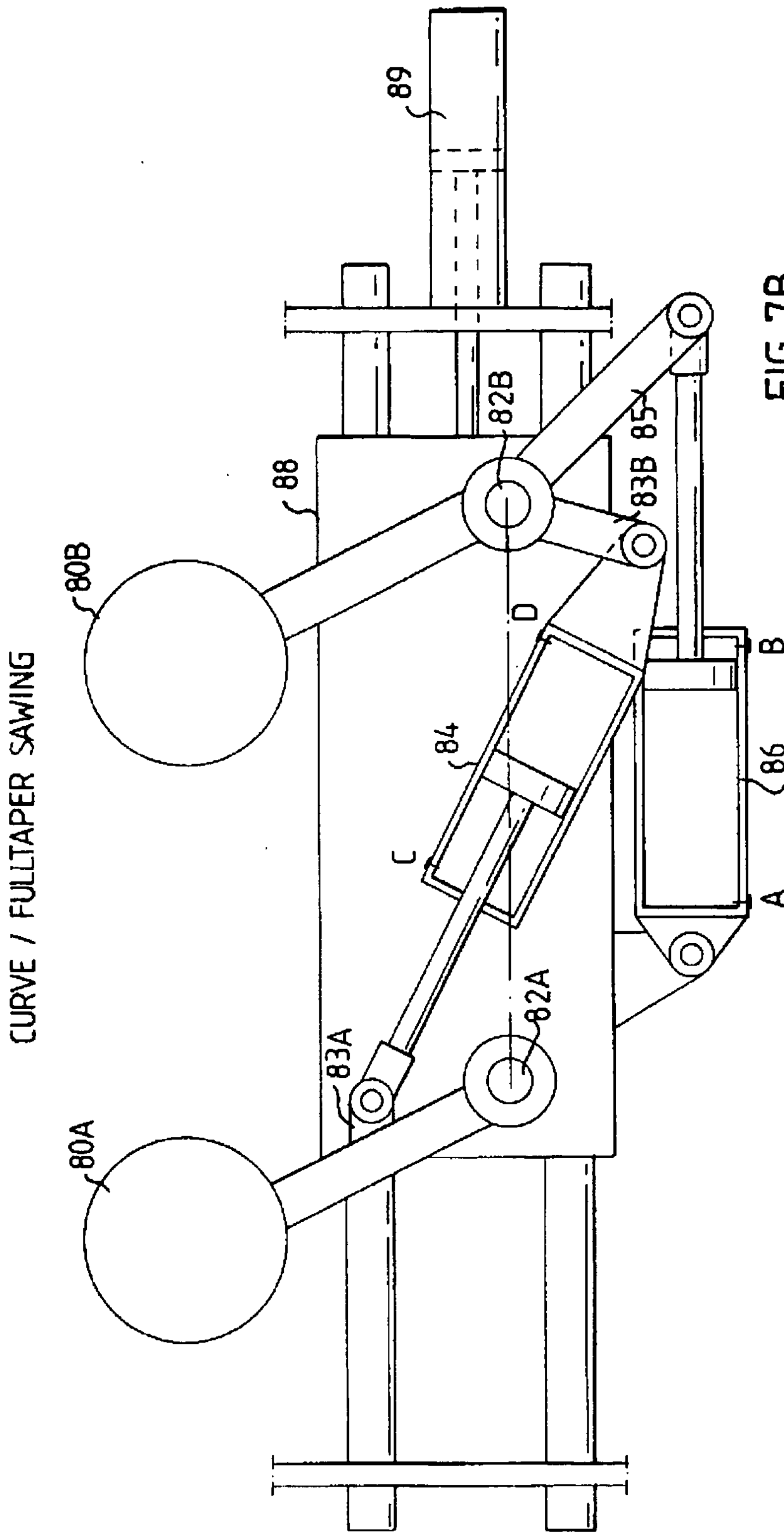

FIG. 7B

CENTERING / LINEBAR ROLLER INFEED

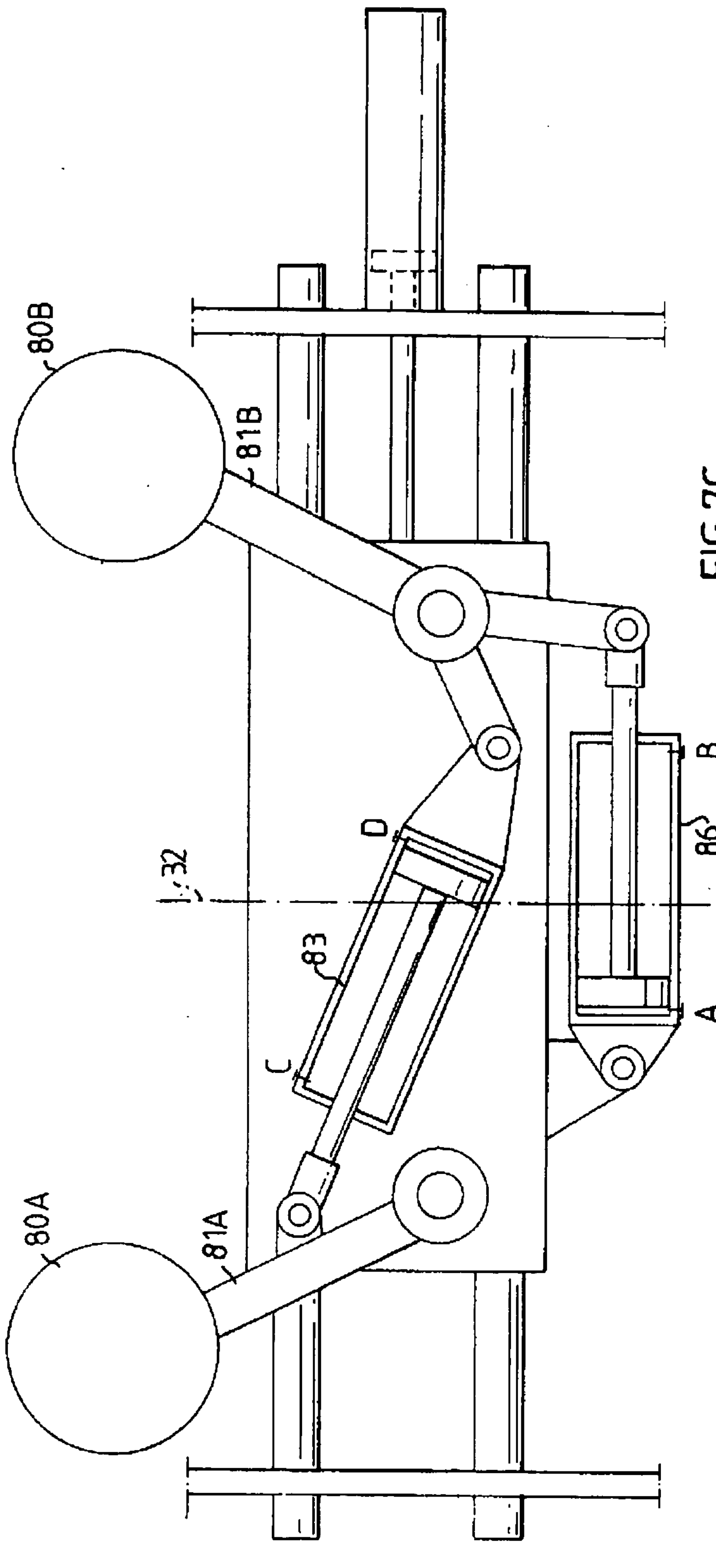

FIG.7C

2022857

HYDRAULIC SCHEME, CURVE SAWING DEV. IN CHIPPERCANTER

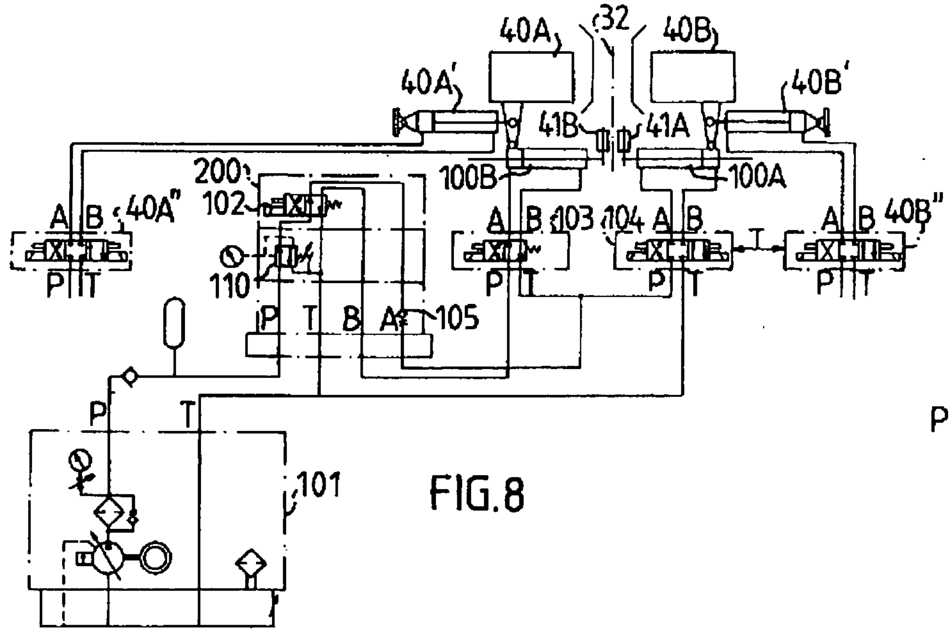

FIG.8

CURVE / CENTER SAWING

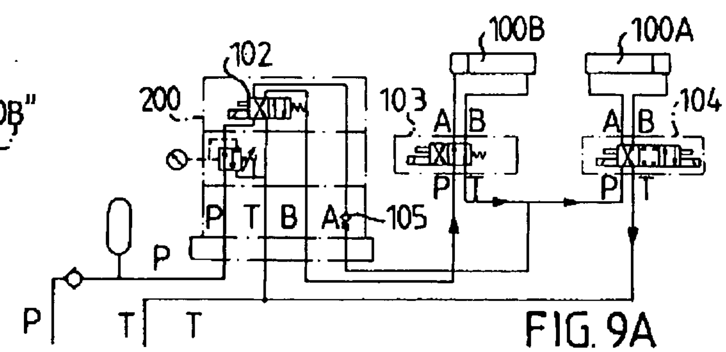

FIG. 9A

CURVE / FULLTAPER SAWING

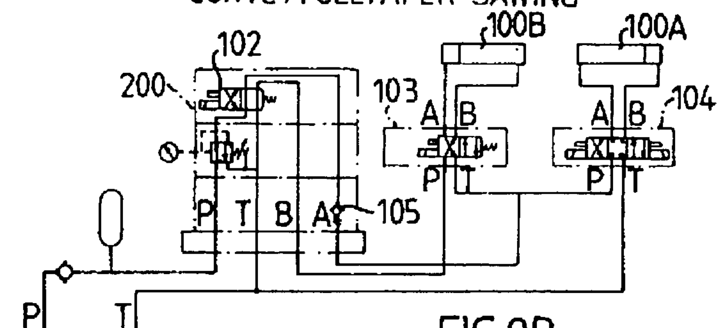

FIG.9B

A

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